Appendix A:
Livestock Measurements and Reference Data

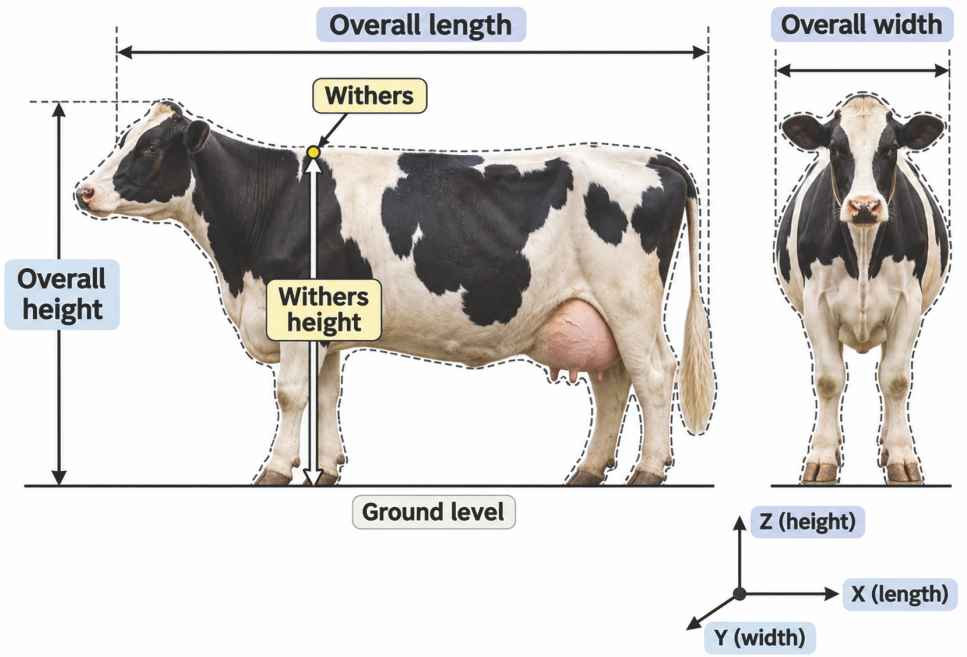
A number is more useful when I know exactly what it measures. Here are the selected dimensions and calculated areas behind my comparisons, collected in one place so I can find them without hunting through the chapter.

The Size of Each Animal

I set each animal to a representative withers height—the distance from the ground to the top of the shoulders. Table A.1 gives those selected heights and the resulting outer dimensions. These are the dimensions of the shapes used in the calculations, not breed averages or tape measurements of living animals.

Overall length, width, and height reach to the farthest point on the shape. A tail can affect length; horns can affect width; an ear or raised head can affect height. None of those is automatically the same as a livestock body-length or chest-width measurement.

The animals face the same direction, with height measured upward from a level ground plane. The Saanen and Belgian are caught in mild steps, so setting the lowest point on the ground does not mean all four feet are planted at once.



Reference axes and exterior measurement landmarks on a standing farm animal. Withers height is measured from ground level; overall length, width, and height describe the farthest points of the complete outline rather than standardized anatomical body measurements.

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Animal / condition	Withers height (m)	Overall length (m)	Overall width (m)	Overall height (m)
Holstein cow	1.500	2.90	0.97	1.71
Holstein bull	1.620	3.12	1.73	1.76
Highland cow	1.160	2.05	0.86	1.53
Suffolk, full fleece	0.800	1.37	0.50	0.97
Suffolk, shorn	0.800	1.30	0.42	0.98
Saanen goat	0.830	1.50	0.39	1.04
Boer goat	0.820	1.49	0.44	1.15
Yorkshire market hog (~275 lb)	0.770	1.48	0.93	0.90
Morgan horse	1.500	2.42	0.59	2.02
Belgian draft horse	1.730	2.86	0.71	2.14
Great Pyrenees	0.762	1.50	0.55	0.94

Selected shoulder-height targets and the resulting overall dimensions of the eleven representative animal shapes, in meters. Overall measurements include projecting features; they are not breed averages or measurements from living animals.

What the Wind Sees

Projected area is the outline facing a particular direction of wind, not the full surface of the animal. The overlap of head, legs, and body is counted only once in a given view.

The next table gives the projected areas at the selected model sizes. Zero degrees is head-on; ninety degrees is broadside. I have kept three decimal places here for anyone checking the arithmetic, not as a claim about the precision of a live animal's measurements.

Animal / condition	Head-on (m^2)	Broadside (m^2)	Broadside / head-on
Holstein cow	0.943	2.194	2.33
Holstein bull	1.797	2.919	1.62
Highland cow	0.869	1.602	1.84
Suffolk, full fleece	0.306	0.646	2.11
Suffolk, shorn	0.248	0.486	1.96
Saanen goat	0.233	0.608	2.61
Boer goat	0.318	0.623	1.96
Yorkshire market hog	0.532	0.727	1.37
Morgan horse	0.703	1.666	2.37
Belgian draft horse	0.959	2.748	2.87
Great Pyrenees	0.319	0.722	2.27

Projected areas at the selected model sizes, with a direct headwind (0°) and true broadside wind (90°). Each area belongs to its particular modeled shape and pose; none is a measured drag force or a breed-wide projected-area standard.

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The Details That Deserve a Second Look

The numbers need a little company. This table identifies the main shape and posture qualifications that can affect how each outline should be understood.

Animal or condition	What to keep in mind
Holstein bull	Prominent horns contribute strongly to the head-on width; they are a feature of this selected representative.
Highland cow	The exterior outline does not individually resolve the full shaggy coat of a living Highland.
Both Suffolk conditions	Both were set to 0.80 m at the withers, but their underlying shapes are not identical.
Saanen goat and Belgian horse	The legs are in mild walking positions rather than a perfectly still, square stance.
Yorkshire market hog	The stated 275 lb is the intended representative weight class, not a verified mass of the model.
Great Pyrenees	Fine long-coat elements contribute to the geometric outline; the calculation does not resolve air passing through fur.
Every animal	Head carriage, limbs, individual condition, and movement can change the shape facing the wind.

Shape and posture qualifications that matter when interpreting the projected areas. The limits concern the modeled comparison, not the real animals' known breed characteristics.

Different Kinds of Evidence

I keep source measurements, selected sizes, and calculated results in separate columns. A grain-yield estimate and a scale ticket may both be useful, but I would never put the same label on them. Table A.4 makes those distinctions explicit for the animal data.

Kind of value	What it tells me	Example
Published measurement	A value measured in a defined group or recorded for a described animal.	Body dimensions reported in a Holstein study.
Selected size	A representative dimension chosen for a particular comparison.	The 1.16 m Highland withers height.
Geometry-derived area	The outline calculated from the fixed three-dimensional shape and viewing angle.	The cow's 2.194 m^2 broadside area.
Conditional force	An equation result that also depends on an assumed coefficient and other stated inputs.	Cow force at 15 mph with an assumed coefficient of 0.80.
Not established	A quantity the available measurements and calculations do not supply.	Actual breed drag coefficient or safe gust threshold.

The distinctions behind the numerical comparisons. Geometry-derived and conditional values are reproducible calculations, not field measurements of wind force.

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